I 13 Applications

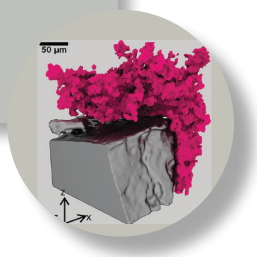
I13-2 – Diamond Manchester Imaging Branchline

I13 is dedicated to imaging and coherence related experiments and has been designed to support a broad range of scientific users from biomedicine, materials science, geophysics, astrophysics, archaeology and engineering applications. It is housed in a building 250 metres away from the main ring building, and similar to other beamlines at Diamond, it exploits Diamond's brilliant X-rays and utilises them in two ways via X-ray Imaging (I13-2) and Coherence (I13-1) branch lines. These branch lines provide different tools, which can which can run simultaneously and independently from each other, for non-destructive examination of internal features ranging from the micrometre to the nanometre length scale.

The Imaging branch performs in-line phase contrast imaging and tomography over a large field of view in the 6-30 keV energy range. The spatial resolution for this technique is in the micron range. In addition it will be possible to switch the instrument to full-field microscopy with 50 nm spatial resolution.

Bio-Medical Research

- Characterise the performance of injectable bone substitutes in promoting bone growth;
- Investigate cochlea structure to understanding hearing;
- Imaging of soft tissues including muscles.

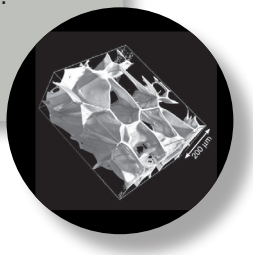


Energy

- Probe of lithium ion batteries;
- Image structures in nuclear storage materials.

Novel Imaging Techniques

- Imaging of biological cell structure;
- Probe the structure and organisation of photonic crystals;
- Reconstruct internal stress fields using coherent diffraction.



Materials

- Study the size distribution of aluminium grains in polycrystalline materials;
- Follow crack propagation in engineering materials;
- Dendritic growth of aluminium-tin alloys.

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The imaging branch operates in two imaging modes:

Micro-imaging

Images are recorded with resolutions up to circa 1µm and a choice of magnifications.

Detector	Objective lens	Total magnification*	Effective pixel size / µm	Field of view / mm
pco.4000	2x 4x 10x	4x 8x 20x	2.3 1.1 0.45	9.0 x 6.0 4.5 x 3.0 1.8 x 1.2
pco.edge 5.5	2x 4x 10x	4x 8x 20x	1.6 0.81 0.33	4.2 x 3.5 2.1 x 1.8 0.83 x 0.70
pco.dimax S	2x 4x 10x	4x 10x 20x	2.8 1.1 0.55	5.5 x 5.5 2.2 x 2.2 1.1 x 1.1

Nano-imaging

An X-ray microscope is used to provide a resolution of approximately 50nm and a field of view of roughly 50µm and is currently undergoing optimisation to improve resolution and exposure times.

pco.4000 (High image quality) 	Scintillator-coupled detector 4008 x 2672 pixels Pixel sixe: 9 µm x 9 µm Dynamic range: 5,455:1 Maximum frame rate at full resolution: 5 Hz Exposure time: 5 µs – 49 days Low noise
pco.edge 5.5 (High image quality) 	Scintillator-coupled detector 2560 x 2160 pixels Pixel sixe: 6.5 µm x 6.5 µm Dynamic range: 27,000:1 Maximum frame rate at full resolution: 100 Hz Exposure time: 500 µs – 2s Very low noise
pco.dimax S (High speed) 	Scintillator-coupled detector 2160 x 2160 pixels Pixel sixe: 11 µm x 11 µm Dynamic range: 1,600:1 Maximum frame rate at full resolution: 1,279 Hz Exposure time: 1.5 µs – 40 ms

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